

Application No.: 10/708,405

Docket No.: 22040-00029-US

AMENDMENTS TO THE CLAIMS

1. (Original) A digital filter, comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output,

the filter factors have a symmetrical sequence and values of the filter factors are set so that a sum of the sequence is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs.

2. (Previously presented) The digital filter according to claim 1, the sequence of filter factors comprising ratios of -1, 0, 9, 16, 9, 0, and -1.

3. (Previously presented) A cascaded digital filter, comprising:
plural digital filters of claim 2 cascaded in a plurality of stages.

4. (Original) A digital filter, comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output,

the filter factors have a symmetrical sequence and values are set so that a sum of the sequence is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs.

5. (Previously presented) A digital filter according to claim 4, wherein the sequence of filter factors comprises ratios of 1, 0, -9, 16, -9, 0, and 1.

6. (Previously presented) A cascaded digital filter, comprising:
plural digital filters of claim 5 cascaded in a plurality of stages.

7. (Canceled).

Application No.: 10/708,405

Docket No.: 22040-00029-US

8. (Original) A digital filter, comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output,

the filter is designed based on first filter factors having a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs, and second filter factors are provided as filter factors for the signals of the taps, the second filter factors being obtained by reversing signs of values other than a median of the sequence of the first filter factors while causing absolute values of the sequence to remain the same.

9. (Original) A digital filter, comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output,

the filter is designed based on first filter factors having a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs, and second filter factors are provided as filter factors for the signals of the taps, the second filter factors being obtained by reversing signs of values other than a median of the sequence of the first filter factors while absolute values of the sequence is caused to remain the same, and subtracting the median of the sequence from a reference value.

10. (Previously presented) The digital filter according to claim 8, wherein the first filter factors comprise a sequence obtained by cascading a basic filter in one or more stages, the basic filter comprising, as filter factors, a sequence comprising ratios of -1, 0, 9, 16, 9, 0, and -1.

11. (Previously presented) The digital filter according to claim 9, the first filter factors comprising a sequence obtained by cascading a basic filter in one or more stages, the basic filter comprising, as filter factors, a sequence comprising ratios of -1, 0, 9, 16, 9, 0, and -1.

Application No.: 10/708,405

Docket No.: 22040-00029-US

12. (Original) A digital filter, comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output,

the filter is designed based on first filter factors having a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs, and second filter factors are provided as filter factors for the signals of the taps, the second filter factors having a sequence in which values are set so that sums of the first filter factors and the second filter factors serve as reference values.

13. (Original) A digital filter, comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output,

the filter is designed based on second filter factors having a symmetrical sequence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs, and first filter factors are provided as filter factors for the signals of the taps, the first filter factors being obtained by reversing signs of values other than a median of the sequence of the second filter factors while causing absolute values of the sequence to remain the same.

14. (Original) A digital filter, comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output,

the filter is designed based on second filter factors having a symmetrical sequence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs, and first filter factors are provided as filter factors for the signals of the taps, the first filter factors being obtained by reversing signs of values other than a median of the sequence of the second filter factors while causing absolute values of the sequence to remain the same, and subtracting the median of the sequence from a reference value.

Application No.: 10/708,405

Docket No.: 22040-00029-US

15. (Previously presented) The digital filter according to claim 13, the second filter factors comprising a sequence obtained by cascading a basic filter in one or more stages, the basic filter comprising, as filter factors, a sequence comprising ratios of 1, 0, -9, 16, -9, 0, and 1.

16. (Previously presented) The digital filter according to claim 14, the second filter factors comprising a sequence obtained by cascading a basic filter in one or more stages, the basic filter comprising, as filter factors, a sequence composed of ratios of 1, 0, -9, 16, -9, 0, and 1.

17. (Original) A digital filter, comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output,

the filter is designed based on second filter factors having a symmetrical sequence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs, and first filter factors are provided as filter factors for the signals of the taps, the first filter factors having a sequence in which values are set so that sums of the first filter factors and the second filter factors serve as reference values.

18. (Original) A digital filter, comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output,

the filter is designed based on first filter factors having a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs, and second filter factors are provided as filter factors for the signals of the taps, the second filter factors being obtained by converting the sequence of the first filter factors and setting values so that a sum of the converted sequence is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs in the converted sequence.

Application No.: 10/708,405

Docket No.: 22040-00029-US

19. (Original) A digital filter comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output,

the filter is designed based on second filter factors having a symmetrical sequence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs, and first filter factors are provided as filter factors for the signals of the taps, the first filter factors being obtained by converting the sequence of the second filter factors and setting values so that a sum of the converted sequence is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs in the converted sequence.

20. (Original) A method of designing a digital filter, the digital filter comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output, the method comprises:

determining filter factors for the signals of the taps by reversing signs of values other than a median of the sequence of basic filter factors while causing absolute values of the sequence to remain the same based on the basic filter factors having a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs.

21. (Original) A method of designing a digital filter, the digital filter comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output, the method comprises:

determining filter factors for the signals of the taps by reversing signs of values other than a median of the sequence of basic filter factors while causing absolute values of the sequence to remain the same, and subtracting the median of the sequence from a reference value, based on the basic filter factors having a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs.

Application No.: 10/708,405

Docket No.: 22040-00029-US

22. (Previously presented) The method of designing the digital filter according to claim 20, wherein the basic filter factors comprise a sequence of ratios of -1, 0, 9, 16, 9, 0, and -1.

23. (Previously presented) The method of designing the digital filter according to claim 21, wherein the basic filter factors comprise a sequence of ratios of -1, 0, 9, 16, 9, 0, and -1.

24. (Original) A method of designing a digital filter, the digital filter comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output, the method comprises:

determining filter factors for the signals of the taps by reversing signs of values other than a median of the sequence of basic filter factors while causing absolute values of the sequence to remain the same based on the basic filter factors having a symmetrical sequence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs.

25. (Original) A method of designing a digital filter, the digital filter comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output, the method comprises:

determining filter factors for the signals of the taps by reversing signs of values other than a median of a sequence of basic filter factors while causing absolute values of the sequence to remain the same, and subtracting the median of the sequence from a reference value, based on the basic filter factors having a symmetrical sequence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs.

26. (Previously presented) The method of designing the digital filter according to claim 24, wherein the basic filter factors comprise a sequence of ratios of 1, 0, -9, 16, -9, 0, and 1.

Application No.: 10/708,405

Docket No.: 22040-00029-US

27. (Previously presented) The method of designing the digital filter according to claim 25, wherein the basic filter factors comprise a sequence of ratios of 1, 0, -9, 16, -9, 0, and 1.

28. (Original) A method of designing a digital filter, the digital filter comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output, the method comprises:

determining filter factors for the signals of the taps by converting the sequence of basic filter factors and setting values so that a sum of the converted sequence is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs in the converted sequence, based on the basic filter factors having a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs.

29. (Original) A method of designing a digital filter, the digital filter comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output, the method comprises:

determining filter factors for the signals of the taps by converting the sequence of basic filter factors and setting values so that a sum of the converted sequence is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs in the converted sequence, based on the basic filter factors having a symmetrical sequence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs.

30. (Currently amended) A method of designing a digital filter, the digital filter comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output, the method comprises:

Application No.: 10/708,405

Docket No.: 22040-00029-US

cascading a basic filter ~~[[ina]]~~ in n stages-(n=1) (n>1), the basic filter being constituted using basic filter factors having a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs, and determining, as filter factors for the signals of the taps, nth-order filter factors obtained thus.

31. (Original) The method of designing the digital filter according to claim 30, signs of values other than a median of a sequence of the nth-order filter factors are reversed while causing absolute values of the sequence to remain the same, and transfer filter factors obtained thus are determined as filter factors for the signals of the taps.

32. (Original) The method of designing the digital filter according to claim 30, signs of values other than a median of a sequence of the nth-order filter factors are reversed while causing absolute values of the sequence to remain the same, the median of the sequence is subtracted from a reference value, and transfer filter factors obtained thus are determined as filter factors for the signals of the taps.

33. (Currently amended) A method of designing a digital filter, the digital filter comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output, the method comprises:

cascading a basic filter ~~[[ina]]~~ in n stages-(n=1) (n>1), the basic filter being constituted using basic filter factors having a symmetrical sequence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs, and determining, as filter factors for the signals of the taps, nth-order filter factors obtained thus.

34. (Original) The method of designing the digital filter according to claim 33, signs of values other than a median of a sequence of the nth-order filter factors are reversed while causing absolute values of the sequence to remain the same, and transfer filter factors obtained thus are determined as filter factors for the signals of the taps.

Application No.: 10/708,405

Docket No.: 22040-00029-US

35. (Original) The method of designing the digital filter according to claim 33, signs of values other than a median of a sequence of the nth-order filter factors are reversed while causing absolute values of the sequence to remain the same, the median of the sequence is subtracted from a reference value, and transfer filter factors obtained thus are determined as filter factors for the signals of the taps.

36. (Original) The method of designing the digital filter according to claim 30, a pass frequency band of the filter is shifted by changing a delay rate of the delay unit.

37. (Original) The method of designing the digital filter according to claim 33, a pass frequency band of the filter is shifted by changing a delay rate of the delay unit.

38. (Original) A method of designing a digital filter, the digital filter comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output, the method comprises:

shifting a pass frequency band of the filter by changing a delay rate of the delay unit in a basic filter constituted using basic filter factors having a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs.

39. (Original) A method of designing a digital filter, the digital filter comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output, the method comprises:

shifting a pass frequency band of the filter by changing a delay rate of the delay unit in a basic filter constituted using basic filter factors having a symmetrical sequence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs.

40. (Original) The method of designing a digital filter, comprising:

Application No.: 10/708,405

Docket No.: 22040-00029-US

a filter using the filter factors obtained by the designing method according to claim 30 is cascaded in m stages ($m = 1$), so that a pass frequency band of the filter is adjusted.

41. (Original) The method of designing a digital filter, comprising:

a filter using the filter factors obtained by the designing method according to claim 33 is cascaded in m stages ($m = 1$), so that a pass frequency band of the filter is adjusted.

42. (Original) The method of designing a digital filter, comprising:

a filter using the filter factors obtained by the designing method according to claim 38 is cascaded in m stages ($m = 1$), so that a pass frequency band of the filter is adjusted.

43. (Original) The method of designing a digital filter, comprising:

a filter using the filter factors obtained by the designing method according to claim 39 is cascaded in m stages ($m = 1$), so that a pass frequency band of the filter is adjusted.

44. (Canceled).

45. (Currently amended) A method of designing a digital filter, the digital filter comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output, the method comprises:

cascading a first basic filter ~~[[m]]~~ in n stages ($n = 1$) ($n \geq 1$), the first basic filter being constituted using first basic filter factors having a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs, and shifting a pass frequency band of the filter by changing a delay rate of the delay unit, so that n th-order filter factors are obtained;

cascading a second basic filter in m stages ($m = 1$), the second basic filter being constituted using second basic filter factors having a symmetrical sequence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other

Application No.: 10/708,405

Docket No.: 22040-00029-US

terms with opposite signs, and shifting a pass frequency band of the filter by changing a delay rate of the delay unit, so that m th-order filter factors are obtained;

cascading the filter using the n th-order filter factors and the filter using the m th-order filter factors; and

reversing signs of values other than a median of the sequence of the filter factors obtained by the cascade connection while causing absolute values of the sequence to remain the same, and subtracting the median of the sequence from a reference value, so that transfer filter factors obtained thus are determined as filter factors for the signals of the taps.

46. (Original) A method of designing a digital filter, the digital filter comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying the signals of taps by given filter factors and then performing addition and output, the method comprises:

based on first filter factors having a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs or having a sequence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs, determining second filter factors obtained when a basic filter constituted using the first filter factors is cascaded in a plurality of stages, the second filter factors are obtained when the basic filter is cascaded for the number of stages where a frequency changing with the number of cascaded stages exceeds a target frequency;

reversing signs of values other than a median of a sequence of the second filter factors while causing the absolute values of the sequence to remain the same based on the determined second filter factors, and subtracting the median of the sequence from a reference value, so that transfer filter factors are obtained;

determining third filter factors obtained when an interim product filter constituted using the transfer filter factors is cascaded in a plurality of stages based on the transfer filter factors, the third filter factors are obtained when the interim product filter is cascaded for the number of

Application No.: 10/708,405

Docket No.: 22040-00029-US

stages where a frequency changing with the number of cascaded stages exceeds the target frequency;

similarly determining, based on the determined third filter factors, transfer factors and filter factors repeatedly, the filter factors being obtained when an interim product filter constituted using the transfer filter factors is cascaded, and reducing an error between a frequency obtained thus and the target frequency to determine final filter factors.

47. (Previously presented) A cascade digital filter arrangement, the arrangement comprising:

a first digital filter comprising at least a first tapped delay line comprising a first plurality of delay units, the first digital filter multiplying signals of taps by given first filter factors and then performing addition and output,

the first filter factors having a first symmetrical sequence and values of the first filter factors being set so that a sum of the first sequence is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs,

wherein the first sequence of filter factors comprises ratios of -1, 0, 9, 16, 9, 0, and -1;
and

in cascade with the first digital filter, a second digital filter, comprising a second tapped delay line made up of a second plurality of delay units, the second digital filter multiplying signals of taps by given second filter factors and then performing addition and output,

the second filter factors having a second symmetrical sequence and values being set so that a sum of the second sequence is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs,

wherein the second sequence of second filter factors comprises ratios of 1, 0, -9, 16, -9, 0, and 1.

Application No.: 10/708,405

Docket No.: 22040-00029-US

48. (Previously presented) A method of designing a cascaded digital filter so that a pass frequency band of the filter is adjusted, the digital filter comprising at least a tapped delay line comprising a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output, the method comprising:

cascading a basic filter in n stages ($n = 1$), the basic filter comprising basic filter factors having a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs, and determining, as filter factors for the signals of the taps, n th-order filter factors thus obtained; and

selecting and arbitrarily cascading a filter using the filter factors obtained by the designing method according to any one of claims 33, 38, and 39, so that a pass frequency band of the filter is adjusted.

49. (Previously presented) A method of designing a digital filter so that a pass frequency band of the filter is adjusted, the digital filter comprising at least a tapped delay line comprising a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output, the method comprising:

cascading a basic filter in n stages ($n = 1$), the basic filter being constituted using basic filter factors having a symmetrical sequence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs, and determining, as filter factors for the signals of the taps, n th-order filter factors thus obtained; and

selecting and arbitrarily cascading a filter using the filter factors obtained by the designing method according to any one of claims 30, 38, and 39, so that a pass frequency band of the filter is adjusted.

50. (Previously presented) A method of designing a digital filter so that a pass frequency band of the filter is adjusted, the digital filter comprising at least a tapped delay line comprising a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output, the method comprising:

Application No.: 10/708,405

Docket No.: 22040-00029-US

shifting a pass frequency band of the filter by changing a delay rate of the delay unit in a basic filter constituted using basic filter factors having a symmetrical sequence in which values are set so that a sum is not zero and a sum of every other terms is equal to a sum of the other every other terms with the same signs; and

selecting and arbitrarily cascading a filter using the filter factors obtained by the designing method according to any one of claims 30, 33, and 39, so that a pass frequency band of the filter is adjusted.

51. (Previously presented) A method of designing a cascaded digital filter, the digital filter comprising a tapped delay line made up of a plurality of delay units, the digital filter multiplying signals of taps by given filter factors and then performing addition and output, the method comprising:

shifting a pass frequency band of the filter by changing a delay rate of the delay unit in a basic filter constituted using basic filter factors having a symmetrical sequence in which values are set so that a sum is zero and a sum of every other terms is equal to a sum of the other every other terms with opposite signs; and

selecting and arbitrarily cascading a filter using the filter factors obtained by the designing method according to any one of claims 30, 33, and 38, so that a pass frequency band of the filter is adjusted.